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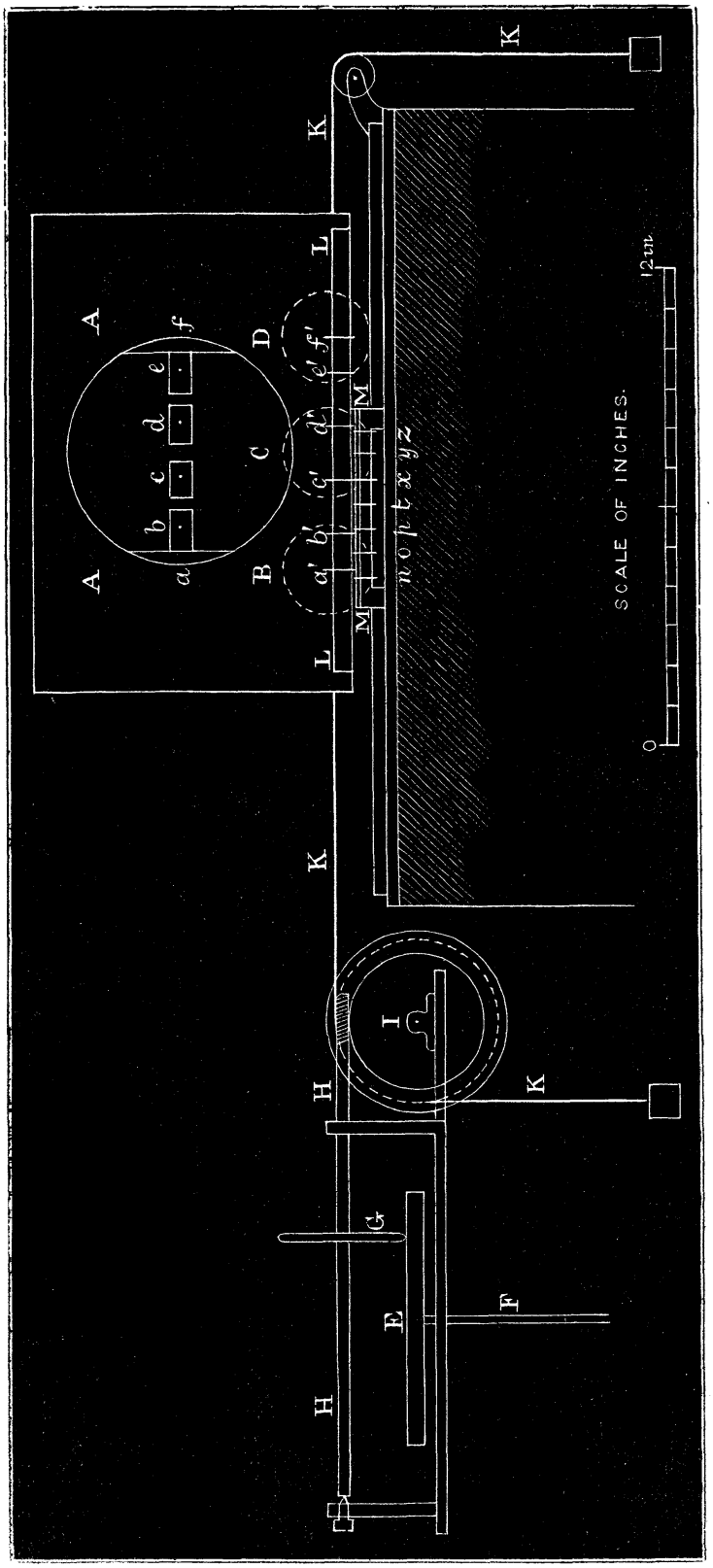
J. W. L. GLAISHER, Sc.D., F.R.S., President, in the Chair.

Thomas Bauchope, East Brucefield, West Calder, Scotland, was balloted for and duly elected a Fellow of the Society.

Description of the Personal Equation Machine of the Royal Observatory, Greenwich. By W. H. M. Christie, M.A., F.R.S., Astronomer Royal.

This apparatus was planned with a view of determining absolute personal equations, the variations of personal equation depending upon the direction of movement, the velocity, and the magnitude of the star observed, and personality in observations of limbs of the Sun, Moon, or planets. It was arranged that the transit-circle should be used for the determinations, and a point which I specially aimed at was that the conditions of the ordinary observations of the heavenly bodies should be reproduced as closely as possible. Generally speaking, this personal equation machine is on the lines of that devised by M. C. Wolf, and described by him in vol. viii. of the *Annales de l'Observatoire de Paris;* but, as the objects in view were somewhat different, various modifications in the general plan were introduced. Amongst these may be mentioned the much larger dimensions of the apparatus (in consequence of which it is not necessary to use a lens of short focus to form a diminished image of the artificial object), the use of the transit-circle micrometer for adjustment of the contacts to the true transit over the wires, and the use of reflected sunlight, moonlight, or diffused daylight, instead of lamplight. This being premised, I proceed to describe the construction of the apparatus, which was made by Messrs. Troughton & Simms with their usual skill.



An object-glass of $7\frac{1}{2}$ inches aperture, and of about 51 feet focal length, is attached in front of the object-glass of the transit-circle, the telescope tube of the latter being horizontal and pointing north. This long-focus object-glass forms, in fact, a reversed telescope or collimator, in the focus of which is the vertical plate A of the personal equation machine, apertures in which, illuminated by sunlight, moonlight, or diffused skylight reflected from a plane mirror behind, form the artificial objects to be observed. A circular aperture in the plate 6 inches in diameter represents the Sun or Moon, and as only the portions *a*, *f*, near the ends of the horizontal diameter, are required for observations of first and second limbs, the remainder of the aperture is filled by a plate carrying four small pinholes *b*, *c*, *d*, *e* (to represent stars of different magnitudes) adjustable in a horizontal slide. The vertical plate is mounted on a carriage with three grooved wheels (B, C, D) running on two horizontal rails, and carried smoothly by clockwork from east to west, or west to east, at a rate which, by means of an ingenious contrivance devised by Mr. James Simms, may be varied at will from that of a very close circumpolar star to about three times that of an equatorial star. The movement of the vertical plate is effected in the following manner:—A horizontal circular brass plate E is attached to the vertical spindle F of an equatorial driving clock (belonging to one of the photoheliographs), and is thus made to rotate uniformly at a determinate speed. This plate drives by rolling friction a brass disc G, turning about a horizontal axis H, and placed with its rim in contact with the plate. The disc G can be slipped along its spindle and clamped at any point, so that the point of contact of the disc and plate can be adjusted at will to any distance from the centre of the latter, the angular velocity of the disc varying directly as this distance, and changing sign at the centre. At the further end of the spindle is a screw which gears into a toothed wheel I, and communicates the motion to the vertical plate by means of a pulley-wheel (in the same casting with the toothed wheel), and a cord K kept in tension by weights at each end. The carriage on which the vertical plate is mounted can be attached to any convenient point of the cord.

The transits of the artificial sun, or moon and stars can thus be observed with the transit-circle under practically the same conditions as the real objects. At the same time, the true times of transit over the wires are registered automatically on a chronograph by means of the contacts between two sets of platinum studs, one set (a', b', c', d', e', f') corresponding to the artificial objects and carried with the plate, the other set (n, o, p, q, r, s, t, u, v, w, x, y, z) fixed and corresponding to the wires of the transit-circle. [In the diagram q, r, s, u, v, w are omitted to avoid confusion.] The platinum studs are carefully rounded at the parts where contact is made (so that the contact surfaces are hemispheres) and are let into the ends of small brass screws,

which are tapped through insulated narrow brass plates L, M, having thin plates of ebonite (with holes through which the studs project very slightly) on their under and upper surfaces respectively. The studs can thus be readily adjusted vertically to give good contact without interfering with the smooth motion of the vertical plate. For the adjustment of the instants of contact to the times of true transit over the wires, the right ascension micrometer of the transit-circle is used to move the wires so that they respectively bisect the artificial object when it is brought (by slowly turning the spindle of the screw which actuates the pulley wheel) into the respective positions for which contact is made by its stud with each of the studs corresponding to the wires. The readings of the R.A. micrometer are taken for the bisection of the artificial star by each wire, and the micrometer is set to the mean of the readings. A reversion-prism eyepiece is used in these adjustments to eliminate any personality in bisection of a stationary object. Thus the mean of the true times of transit over the wires is adjusted to agree precisely with the mean of the instants of contact with the corresponding studs.

In observations of limbs I propose to use an artificial star as a point of reference, measuring the distance between the artificial limb and star on the plate with a micrometer microscope, and also in the field of view of the transit-circle with the R.A. micrometer. The scale would be given by measuring the distance between two stars on the plate and in the field of the transit-circle. In this way personality in the bisection of a stationary limb would be determined, and the personality in observations of a first or second limb would be found by means of transits. It may be remarked that the reversion-prism eyepiece gives facilities for converting the preceding or following limb (*a* or *b*) into an upper or lower limb, so that personality in N.P.D. observations of limbs can be thus determined.

Plates with apertures representing the various planets may be substituted for any of the four *b*, *c*, *d*, *e*.

Royal Observatory, Greenwich:
1887, *November* 19.

Results obtained with the Personal Equation Machine at the Royal Observatory, Greenwich. By H. H. Turner, M.A., B.Sc.

A full description of the Personal Equation Machine is given by the Astronomer Royal in the preceding paper. Observations were made with this instrument in 1885 and 1886, but, owing to pressure of other work, little more was done than was necessary to test the general practicability of the measures. A series of transits of an artificial star was observed by several observers, the apparent rate of motion being a little greater than that of an equatorial star, and alternately towards